

[002] FIELD OF THE INVENTION

[003] The present invention concerns a multistage, automatic transmission with at least three individual planet gear sets and at least five shifting elements, all in accord with the principal concept of patent claim 1.

[004] BACKGROUND OF THE INVENTION

[010] ~~In accord with the invention, the purpose is achieved by means of a multistage automatic transmission, having the features of the patent claim 1. Advantageous embodiments and improvements of the invention may be inferred from the subordinate claims.~~

[011] SUMMARY OF THE INVENTION

[024] BRIEF DESCRIPTION OF THE DRAWINGS

[025] ~~In the following, the invention will now be explained and described in greater detail with the aid of Figures from a drawing, wherein similar elements are provided even with the same reference numbers. There is shown in: by way of example, with reference to the accompanying drawings in which:~~

[039] DETAILED DESCRIPTION OF THE INVENTION

ABSTRACT OF THE DISCLOSURE

A multi-stage automatic transmission possesses an input drive shaft (AN), an output drive shaft (AB), three single planetary gear sets (RS1, RS2, RS3) as well as five shifting elements (A to E), via the pairwise selective closure of which, an entry speed of rotation of the input drive shaft (AN) can be transmitted to the output drive shaft (AB) without group shifting. A sun gear (SO3) of the third planetary gear set (RS3) can be set motionless by the first shifting element (A) on the transmission housing (GG). The input drive shaft (AN) is bound to a sun gear (SO2) of the second planetary gear set (RS2) and via the second shifting element (B) can be connected with a sun gear (SO1) of the first planetary gear set (RS1) and via of the fifth shifting element (E) with a spider (ST1) of the first planetary gear set (RS1). Alternatively, the sun gear (SO1) of the first planetary gear set (RS1), via the third shifting element (C) and/or the spider (ST1) of the first planetary gear set (RS1) via the fourth shifting element (D) can be affixed to the transmission housing (GG). The output drive shaft (AB) is connected to an internal gear (HO1) of the first planetary gear set (RS1) and connected to one of the spiders (ST2, ST3) of the second or third planetary gear sets (RS2, RS3). The first planetary gear set (RS1) is fully penetrated centrally in the axial direction only by the input drive shaft (AN), whereby the fifth shifting element (E), when observed spatially, is set between the first and the second planetary gear sets (RS1, RS2), and wherein the second, third and fourth shifting elements (B, C, D) are placed on that side of the first planetary gear set (RS1) which is remote from the fifth shifting element.

1-61. (CANCELED)

62. (NEW) A multi-stage automatic transmission comprising:

an input drive shaft (AN), and an output drive shaft (AB);

at least a first, a second and a third shifting elements (a to E);

at least a first, a second and a third planetary gear sets (RS1, RS2, RS3)

aligned coaxially to one another with the second planetary gear set (RS2) positioned between the first and the third planetary gear sets (RS1, RS3);

a sun gear (SO3) of the third planetary gear set (RS3) is secured above the first shifting element (A) and a transmission housing (GG) of the multi-stage automatic transmission,

a sun gear (SO2) of the second planetary gear set (RS2) is connected with the input drive shaft (AN), and the input drive shaft (AN) is connected by at least one of the second shifting element (B) with a sun gear (SO1) of the first planetary gear set (RS1) and the fifth shifting element (E) with a spider (ST1) of the first planetary gear set (RS1);

alternatively, a sun gear (SO1) of the first planetary gear set (RS1) is affixed, by one of the third shifting element (C) and the spider (ST1) of the first planetary gear set (RS1) via the fourth shifting element (D), to the transmission housing (GG);

the output drive shaft (AB) is connected with an internal gear HO1 of the first planetary gear set (RS1) and with one of the spiders (ST2, ST3) of the second or the third planetary gear set (RS2, RS3); and

wherein at least one of the first planetary gear set (RS1) and the second planetary gear set (RS2) are centrally and completely penetrated in the axial direction by a shaft.

63. (NEW) The multi-stage automatic transmission according to claim 61, wherein the shaft, which penetrates at least one of the first and the second planetary gear set (RS1, RS2) in an axial direction, is the input drive shaft (AN).

64. (NEW) The multi-stage automatic transmission according to claim 61, wherein the fifth shifting element (E) is positioned between the first and the second planetary gear set (RS1, RS2).

65. (NEW) The multi-stage automatic transmission according to claim 61, wherein the connective element between the spider (ST1) of the first planetary gear

set (RS1) and the internal gear (HO2) of the second planetary gear set (RS2) is a disk carrier of the fifth shifting element.

66. (NEW) The multi-stage automatic transmission according to claim 65, wherein a combining element between the spider (ST1) of the first planetary gear set (RS1) and the internal gear (HO2) of the second planetary gear set (RS2) is designed as an outside disks carrier for the acceptance of friction disks of the fifth shifting element (E).

67. (NEW) The multi-stage automatic transmission according to claim 61, wherein the second shifting element (B) is placed upon that side of the first planetary gear set (RS1) which lies opposite to the fifth shifting element (E).

68. (NEW) The multi-stage automatic transmission according to claim 61, wherein the third and fourth shifting element (C, D) is placed upon that side of the first planetary gear set (RS1) which lies opposite to the fifth shifting element (E).

69. (NEW) The multi-stage automatic transmission according to claim 67, wherein the second, third and fourth shifting elements (B, C, D) are placed on one side of the first planetary gear set (RS1), which side is proximal to a motor of the multi-stage automatic transmission which is operationally connected to the input drive shaft (AN).

70. (NEW) The multi-stage automatic transmission according to claim 61, wherein the third and fourth shifting elements (C, D) are placed next to one another, as seen in the axial direction and are in a zone radially located above the planetary gear sets (RS1, RS2, RS3).

71. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (510) of the fifth shifting element (E) is located on the input drive shaft (AN), which is the shaft which centrally penetrates the first planetary gear set (RS1).

72. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (510) of the fifth shifting element (E) activates the disks (500) of the fifth shifting element (E) axially in the direction of the first planetary gear set (RS1).

73. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (510) of the fifth shifting element (E) activates the disks (500) of the fifth shifting element (E) axially in the direction of the second planetary gear set (RS2).

74. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (210) of the second shifting element (B) is placed nearer to the first planetary gear set (RS1) than is a servo apparatus (310) of the third shifting element (C).

75. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (210) of the second shifting element (B) is placed immediately proximal to the first planetary gear set (RS1).

76. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (210) of the second shifting element B activates the disks (200) of the second shifting element (210) axially in a direction contrary to the first planetary gear set (RS1).

77. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (210) of the second shifting element (B) is placed immediately proximal to a transmission housing affixed wall (GW), which forms an outer wall of the transmission housing (GG).

78. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (210) of the second shifting element (B) activates the disks (200) of the second shifting element (B) axially in the direction of the first planetary gear set (RS1).

79. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (210) of the second shifting element (B) is bearingly supported on sun gear (SO1) of the first planetary gear set (RS1).

80. (NEW) The multi-stage automatic transmission according to claim 62, wherein the servo apparatus (210) of the second shifting element (B) is bearingly supported on the input drive shaft (AN).

81. (NEW) The multi-stage automatic transmission according to claim 61, wherein at least one of a servo apparatus (310) of the third shifting element (C) and a servo apparatus (410) of the fourth shifting element (D), is integrated in a transmission-housing affixed housing wall (GW), which forms an outside wall of the transmission housing (GG).

82. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (310) of the third shifting element (C) is placed radially underneath the servo apparatus (410) of the fourth shifting element (D).

83. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (300, 400) of the third and fourth shifting elements (C, D) border axially on the housing wall (GW).

84. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (200) of the second shifting element (B) are placed closer to the first planetary gear set (RS1) than are the disks (400) of the fourth shifting element (D).

85. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (300) of the third shifting element (C) are placed radially underneath the disks (400) of the fourth shifting element (D).

86. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (200, 300) of the second and third shifting element (B, C) border axially on the housing wall (GW).

87. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (400) of the fourth shifting element (D) are placed nearer to the first planetary gear set (RS1) than are the disks (200) of the second shifting elements (B).

88. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (300) of the third shifting element (C) are placed radially underneath the disks (200) of the second shifting element (B).

89. (NEW) The multi-stage automatic transmission according to claim 61, wherein an activation stamp (416) of the servo apparatus (410) of the fourth shifting element (D) partially overlaps the disks (200) of the second shifting element (B) in a radial direction.

90. (NEW) The multi-stage automatic transmission according to claim 61, wherein the activation stamp (416) of the servo apparatus (410) of the fourth shifting element (D) partially overlaps the servo apparatus (210) of the second shifting element (B) in the axial direction.

91. (NEW) The multi-stage automatic transmission according to claim 89, wherein the activation stamp (416) of the servo apparatus (410) of the fourth shifting element (D) penetrates a restorative element (413) of the servo apparatus (410) of the fourth shifting element (D) in the axial direction.

92. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (410) of the fourth shifting element (D) possesses two

pressure spaces (411a, 411b), wherein the differential pressure between the two acts upon the disks (400) of the fourth shifting element (D).

93. (NEW) The multi-stage automatic transmission according to claim 89, wherein the second pressure space (411b) of the servo apparatus (410) of the fourth shifting element (D) is formed by the construction of a section of the transmission housing (GG) and the activation stamp (416) of the servo apparatus (410) of the fourth shifting element (D).

94. (NEW) The multi-stage automatic transmission according to claim 61, wherein the disks (200, 300, 400) of the second, third and fourth shifting elements (B, C, D) border axially on the housing wall (GW).

95. (NEW) The multi-stage automatic transmission according to claim 61, wherein the disks (300) of the third shifting element (C) are placed radially underneath the disks (200) of the second shifting element (B) and the disks (200) of the second shifting element (B) is placed radially under the disks (400) of the fourth shifting element (D).

96. (NEW) The multi-stage automatic transmission according to claim 61, wherein the friction disks of the third shifting element (C) and/or the friction disks of the fifth shifting element (E) possess a come-along toothing on their outer diameter.

97. (NEW) The multi-stage automatic transmission according to claim 61, wherein disks (300) of the third shifting element (C) are placed nearer to the second shifting element (B) than are the disks (400) of the fourth shifting element (D).

98. (NEW) The multi-stage automatic transmission according to claim 61, wherein a servo apparatus (310) of the third shifting element (C) and/or a servo apparatus (410) of the fourth shifting element (D) is integrated into the transmission housing (GG) or is integrated into a disks carrier of the third/fourth shifting element (C, D) which said carrier is non-rotatably affixed to the transmission housing (GG).

99. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (310) of the third shifting element (C) activates the disks (300) of the third shifting element (C) axially in the direction of the second shifting element (B).

100. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (310) of the third shifting element (C) activates the

disks (300) of the third shifting element (C) axially in the direction of the second shifting element (B).

101. (NEW) The multi-stage automatic transmission according to claim 61, wherein the servo apparatus (310) of the third shifting element (C) possesses an activation direction counter to the servo apparatus (410) of the fourth shifting element (D).

102. (NEW) The multi-stage automatic transmission according to claim 61, wherein the first shifting element (A) is placed on that side of the third planetary gear set (RS3) which is remote from the second planetary gear set (RS2).

103. (NEW) The multi-stage automatic transmission according to claim 102, wherein the first shifting element (A) borders onto the third planetary gear set (RS3).

104. (NEW) The multi-stage automatic transmission according to claim 61, wherein the first shifting element (A) is non-rotatably bound onto an outside wall of the transmission housing (GG) or is so bound on a transmission housing (GG) cover and thus forms an outer wall of the said automatic transmission.

105. (NEW) The multi-stage automatic transmission according to claim 61, wherein an outside disks carrier of the first shifting element (A) is integrated into the transmission housing (GG) or into a transmission housing cover which is non-rotatably affixed to the transmission housing (GG).

106. (NEW) The multi-stage automatic transmission according to claim 102, wherein a servo apparatus (110) of the first shifting element (A) is integrated into the transmission housing (GG) or is integrated into a transmission housing wall affixed to said transmission housing.

107. (NEW) The multi-stage automatic transmission according to claim 61, wherein a total of eight axial bearings (AX1 to AX8) are provided for the axial support of components which are located within the transmission housing GG.

108. (NEW) The multi-stage automatic transmission according to claim 107, wherein axial bearings (AX1 to AX8) are provided in two different sizes.

109. (NEW) The multi-stage automatic transmission according to claim 61, wherein within the transmission housing (GG), a total of four rotating sealing rings (RR1 to RR4) are provided for the dynamic sealing of individual pressure and lubrication medium feed means from one another and from other components.

110. (NEW) The multi-stage automatic transmission according to claim 61, wherein the input drive shaft (AN) and the output drive shaft (AB) are aligned coaxially to one another.

111. (NEW) The multi-stage automatic transmission according to claim 109, wherein the output drive shaft (AB), which is operationally bound to the interior gear (HO1) of the first planetary gear set (RS1) centrally penetrates through the third planetary gear set (RS3) in the axial direction.

112. (NEW) The multi-stage automatic transmission according to claim 110, wherein the output drive shaft (AB), which is operationally bound to the interior gear (HO1) of the first planetary gear set (RS1) centrally penetrates, in an axial direction, a clutch space of the first shifting element (A), which space is formed by a disks carrier and/or the servo apparatus (110) of the first shifting element (A).

113. (NEW) The multi-stage automatic transmission according to claim 110, wherein the input drive shaft (AN) is bearingly supported within the output drive shaft (AB).

114. (NEW) The multi-stage automatic transmission according to claim 61, wherein the input drive shaft (AN) and the output drive shaft (AB) do not run coaxial to one another, and the input drive shaft (AN) and the output drive shaft (AB) run axis-parallel to one another or are set at an angular disposition.

115. (NEW) The multi-stage automatic transmission according to claim 114, wherein to accomplish the operational connection between the output drive shaft (AB) and the internal gear (HO1) of the first planetary gear set (RS1) at least one first spur gear (STR1) is provided, which is placed in the zone radially above the first and/or the second/ and or the third planetary gear set (RS1, RS2, RS3).

116. (NEW) The multi-stage automatic transmission according to claim 114, wherein to achieve an operational connection between the output drive shaft (AB) and the internal gear (HO1) of the first planetary gear set (RS1), at least one first spur gear (STR1) is provided, which is placed axially between the third planetary gear set (RS3) and the first shifting element (A).

117. (NEW) The multi-stage automatic transmission according to claim 114, wherein to achieve an operational connection between the output drive shaft and the internal gear (HO1) of the first planetary gear set (RS1), at least a first spur gear (STR1) is provided which is placed axially between the first shifting element (A) and an outer

wall of the transmission housing (GG), and is axially between the first shifting element (A) and a transmission housing cover which is non-rotatably affixed to the transmission housing (GG).

118. (NEW) The multi-stage automatic transmission according to claim 114, wherein for the achievement of an operational connection between that output drive shaft (AB) and the internal gear (HO1) of the first planetary gear set (RS1), at least one first spur gear (STR1) is provided, which borders axially onto a outer wall of the transmission housing (GG), and borders onto transmission housing cover, which cover is non-rotatably bound to the transmission housing (GG).

119. (NEW) The multi-stage automatic transmission according to claim 61, wherein the internal gear (HO1) of the first planetary gear set (RS1) and the spider (ST3) of the third planetary gear set (RS3) and the output drive shaft (AB) are continually in contact with one another, and in that the spider (ST2) of the second planetary gear set (RS2) is continually bound with an internal gear (HO3) of the third planetary gear set (RS3) and further, in that the spider (ST1) of the first planetary gear set (RS1) is continually bound to an internal gear (HO2) of the second planetary gear set (RS2).

120. (NEW) The multi-stage automatic transmission according to claim 61, wherein the internal gear (HO1) of the first planetary gear set (RS1) and the spider (ST2) of the second planetary gear set (RS2) and the output drive shaft (AB) are continually connected with one another and in that the spider (ST3) of the third planetary gear set (RS3) is continually bound with an internal gear (HO2) of the second planetary gear set (RS2) and in that the spider (ST1) of the first planetary gear set (RS1) is continually in contact with an internal gear (HO3) of the third planetary gear set (RS3).

121. (NEW) The multi-stage automatic transmission according to claim 61, wherein by means of selective closure of the shifting elements (A to E) at least six forward gears may be shifted into, and in that for the re-shifting from one gear to the next successive higher gear, or to the next successive lower gear, from the existing active shifting element, respectively one shifting element is opened and another shifting element is closed.

122. (NEW) The multi-stage automatic transmission according to claim 61, wherein in the shifting elements are closed as follows: in the first forward gear, the first

and fourth shifting elements (A, D), in the second forward gear, the first and third shifting elements (A, C) and in the third forward gear, the first and second shifting element (A, B), in the fourth forward gear, the first and fifth shifting element (A, E), in the fifth forward gear, the second and fifth shifting element (B, E), in the sixth forward gear, the third and fifth shifting element (C, E), and in reverse gear, the second and fourth shifting element (B, D).

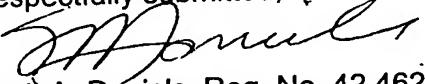
REMARKS

The above newly entered/amended paragraph(s) of the specification overcome some informalities noted in the specification. The undersigned avers that the newly entered/amended paragraph(s) of the specification do not contain any new subject matter.

Please consider new claims 62-122 upon consideration of this application.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,



Scott A. Daniels, Reg. No. 42,462

Customer No. 020210

Davis & Bujold, P.L.L.C.

Fourth Floor

500 North Commercial Street

Manchester NH 03101-1151

Telephone 603-624-9220

Facsimile 603-624-9229

E-mail: patent@davisandbujold.com

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service, with sufficient postage, as First Class Mail in an envelope addressed to: Director of the United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450.
October 17, 2003.

By: 

Print Name: Scott A. Daniels